SPEAKEASY

INSTALLATION

and

OPERATIONS MANUAL

VERSION 1.2

PERSONAL PERIPHERAL PRODUCTS
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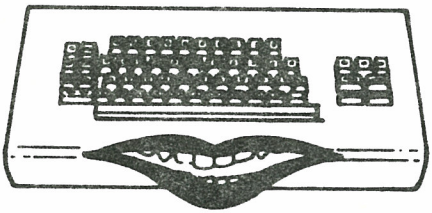

1. GENERAL

SPEAKEASY is a human voice speech synthesizer designed for the VIC-20 computer. SPEAKEASY consists of a single printed circuit board that plugs into VIC's memory expansion port or into a memory expansion board. SPEAKEASY uses the 1K block of address space decoded by the VIC I02 signal. SPEAKEASY will not conflict with your expanded memory board or with your game cartridge. SPEAKEASY will not conflict with any other device unless that device also uses I02.

2. INSTALLATION

Installation of the SPEAKEASY is very easy. You must first determine what speaker you would like to use. You have two choices: an external speaker or the speaker in your television. If you choose an external speaker, make certain that it is 8 ohms and connect it to the supplied jack using two wires. If you want to use your televsison speaker, take one wire and connect it to the center post on the plug. Open up the RF modulator box (the black box that connects your VIC to the TV) by removing the one screw. Locate the yellow wire coming from your VIC, connect the wire from the SPEAKEASY plug to the same place that the yellow wire goes. Replace the RF modulator cover. Insert the plug into the jack on the SPEAKEASY board.

Plug the SPEAKEASY into the VIC's memory expansion port or into a memory expansion mother board. Make certain that the board is plugged in properly. The components should be either up or toward the VIC depending on whether an expansion board is used.

SPEAKEASY has two adjustments that the user can vary: volume and overall speech pitch. There are two pots located on the SPEAKEASY board. When the board is plugged in, the left pot controls the overall speech pitch and the right pot controls the volume. The user should adjust these pots to achieve the best speech.

3. PHONEMES

The heart of SPEAKEASY is a VOTRAX SC-01 integrated circuit. SPEAKEASY is capable of pronouncing 64 phonemes, each at four different inflection levels. The basic idea is to use these 64 phonemes and 4 inflection levels to generate intelligible speech. By stringing selected phonemes together in a determined order any English word can be spoken.

Table 1 is a list of standard VOTRAX phoneme symbols and their associated hex code, duration in milliseconds, and an example of how each phoneme sounds. Table 3 is a dictionary of words and their associated phoneme strings.

4. PROGRAMMING SPEAKEASY

SPEAKEASY can be used from either a basic or assembly language program. This section explains how to use SPEAKEASY from either type.

The idea of programming is to combine sequences of phonemes into words and then combine the words into sentences. The phoneme sequences can

be generated from experimentation using table 1, from the basic vocabulary list provided in table 3, or from Personal Peripheral Product's software program: "PHONEME EDITOR" (see section 5 for more details).

After selecting a phoneme with a decimal value between 0 and 63, you must also specify which inflection level is to be used. A fixed value is added to the basic phoneme value to specify the inflection level. Table 2 indicates the fixed value required to obtain the desired inflection level. It is recommended that the inflection level be left at 0 until the entire word is intelligible. Inflections have generally only been found to be useful in creating a sentence structure.

When creating sentences it has been found that slow and deliberate speech becomes the most intelligent. There are three phonemes that will generate a silent gap: STOP, PA0, and PA1. The STOP phoneme will cancel all sound and provide a gap, whereas the PA0 and PA1 phonemes will let the sound decay naturally and then provide a gap. Experiment with these gaps to achieve the most intelligible speech.

Using a dictionary to determine the proper way to pronounce a word is very important to achieving the best speech. Remember speech is very subjective. What some people understand others do not. SPEAKEASY's voice sounds like a robot talking. As you work with SPEAKEASY it will become easier to understand. SPEAKEASY is like a person with a foreign accent that you must become accustom to hearing.

Now that you have the phoneme strings that you want to speak, let's move on and write a program.

In order to write a program in either basic or assembly language it is essential that you understand how SPEAKEASY must be interfaced to the software. SPEAKEASY contains two hardware sections that make the software interface very simple: a phoneme and inflection register and a "ready for next phoneme" signal. Each phoneme has a specific duration (refer to table 1). When a new phoneme is written to SPEAKEASY two things occur: the new phoneme is pronounced and the "ready for next phoneme" signal goes to a zero (false). The "ready for next phoneme" signal remains zero until the time equal to the phoneme's duration has elapsed, then it becomes a one (true). When the "ready for next phoneme" signal becomes a one, nothing happens to SPEAKEASY's voice. It continues to pronouce the given phoneme. It is important that the software program monitor the "ready for next phoneme" signal and write a new phoneme as soon as it goes to a one in order to produce the best sounding speech. It is especially important that the software write a "no sound" phoneme at the end of a phrase to essentially turn off SPEAKEASY.

The SPEAKEASY phoneme and inflection register is loaded by writing to address 38912 (hex $9800). The lower 6 bits written to 38912 determine the phoneme and the upper 2 bits determine the inflection level. The SPEAKEASY "ready for next phoneme" signal is sensed by reading from address 38912 (hex $9800). SPEAKEASY is ready for a new phoneme if the value read from 38912 is greater than or equal to 128 (bit 7 = 1). SPEAKEASY is not ready for a new phoneme if the value read is less than 128 (bit 7 =0).

With this structure in mind let's write a basic program to say

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"hello". From table 3 we can get the proper phoneme string: H EH1 UH3 L UH3 .02 U1 PA0. This translates into numeric string: 27,02,35,24,35,52,55,03. The following basic program will say hello:

```
100 READ PH :REM GET NEXT PHONEME
110 IF PEEK(38912)<128 THEN GO TO 110 :REM WAIT TIL READY
120 POKE 38912,PH :REM SET NEXT PHONEME
130 IF PH = 03 THEN STOP :REM QUIT IF DONE
140 GO TO 100 :REM GO AGAIN SO MUCH FUN!!!
150 DATA 27,02,35,24,35,52,55,03
```

The above program will continue to present phonemes to SPEAKEASY until a phoneme with a value of 03 is sent. The following example uses a phoneme count to determine when it is done:

```
100 READ CT :REM GET PHONEME COUNT
110 READ PH :REM GET NEXT PHONEME
120 IF PEEK(38912)<128 THEN GO TO 120 :REM WAIT TIL READY
130 POKE 38912,PH :REM SET NEXT PHONEME
140 CT=CT-1 :REM ADJUST PHONEME COUNT
150 IF CT=0 THEN STOP :REM QUIT IF DONE
160 GO TO 110 :REM ELSE CONTINUE
170 DATA 8,27,02,35,24,35,52,55,03
```

Both of these programs use inflection level 0. Try using other inflection levels by changing the DATA statement. Try other words using table 3 and putting new data into the DATA statements.

Now if you are familiar with assembly language let's try to accomplish the same thing with an assembly routine:

```
SPEAK  LDX #$00
SPEAK1 LDA $9800
       BPL SPEAK1
       LDA PHTBL,X
       STA $9800
       INX
       CMP #$03
       BNE SPEAK1
       BRK
PHTBL  .BYT $1B $02 $23 $18
       .BYT $23 $34 $37 $03
```

This program is the assembly language equivalent of the first basic program example. It will stop when a 03 phoneme is encountered. Note that this program uses a BRK instruction to exit. If the BRK is replaced with an RTS, the routine could be used as a subroutine. Now for the assembly language equivalent of the second basic example:

```
SPEAK  LDY PHTBL
       LDX #$00
SPEAK1 LDA $9800
       BPL SPEAK1
       LDA PHTBL+1,X
       STA $9800
       INX
       DEY
```



```
       BNE SPEAK1
       BRK
PHTBL  .BYT $08 $1B $02 $23
       .BYT $18 $23 $34 $37 $03
```

5. PHONEME EDITOR

If it hasn't become apparent yet, it will shortly, that a program that will help you edit the phoneme strings into their desired sequences will make working with the SPEAKEASY much easier. Personal Peripheral Products provides a program called "phoneme editor" that is a true screen editor for phoneme strings. The program provides a 256 phoneme buffer. With this buffer you can append, insert, and delete phonemes. The phoneme buffer can be stored on tape or disk and recalled later for future use. The phoneme editor also provides a way to speak either a selected part of the buffer or the entire buffer. The phoneme editor provides a way to experiment with different inflection levels. A second program "speak phoneme" is provided to speak the data files created by the phoneme editor. Note that both the phoneme editor and the speak phoneme programs work in the 5K RAM provided with the basic VIC-20 (i.e. they do not require a RAM expansion board). The programs are available in disk and tape versions.

6. PERSONAL PERIPHERAL PRODUCTS LIMITED WARRANTY

PERSONAL PERIPHERAL PRODUCTS warrants to the original purchaser of this product that it shall be free of defects resulting from faulty manufacture of the product or its components for a period of ninety (90) days from the date of purchase. This warranty is void if the hardware has been damaged by accident or unreasonable use, neglect, improper service or other causes not arising out of defects in material or consruction. If your SPEAKEASY fails to operate during the first 90 days, return it postage prepaid and insured, with your name, address, proof of the date of purchase and a brief description of the problem to PERSONAL PERIPHERAL PRODUCTS, P.O. BOX 3423, AURORA, ILLINOIS 60505. If your unit is found to be factory defective during the first 90 days, it will be repaired or replaced at no cost to you. If the unit is found to have been consumer damaged or abused and therefore not covered by the warranty, then you will be advised, in advance, of the repair costs. This warranty is made in lieu of any other express warranty, and except for the foregoing warranty which is exclusive, there is no other express warranty being made. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

If your SPEAKEASY requires service after expiration of the 90 day limited warranty period, PERSONAL PERIPHERAL PRODUCTS will service the board and put it in working condition or replace it with a reconditioned model (at our option), upon receipt of your board, postage prepaid and insured, with your check payable to PERSONAL PERIPHERAL PRODUCTS in the amount $15.00. This offer is void if the SPEAKEASY has been modified or serviced by anyone other than PERSONAL PERIPHERAL PRODUCTS. If this offer is determined by PERSONAL PERIPHERAL PRODUCTS to be void, then you will be advised, in advance, of the repair costs.

When returning a board for service (in warranty or not) please allow 4

to 6 weeks for repair and return.

CODE	SYMBOL	DUR(MS)	EXAMPLE	CODE	SYMBOL	DUR(MS)	EXAMPLE
00/00	EH3	59	less	32/20	A	185	able
01/01	EH2	71	enemy	33/21	AY	65	say
02/02	EH1	121	pleasure	34/22	Y1	80	yellow
03/03	PA0	47	no sound	35/23	UH3	47	direction
04/04	DT	47	button	36/24	AH	250	pot
05/05	A2	71	grade	37/25	P	103	put
06/06	A1	103	grade	38/26	O	185	hold
07/07	ZH	90	vision	39/27	I	185	win
08/08	AH2	71	father	40/28	U	185	who
09/09	I3	55	credit	41/29	Y	103	penny
10/0A	I2	80	inhabit	42/2A	T	71	talk
11/0B	I1	121	indigo	43/2B	R	90	red
12/0C	M	103	money	44/2C	E	185	eat
13/0D	N	80	run	45/2D	W	80	water
14/0E	B	71	ball	46/2E	AE	185	back
15/0F	V	71	vein	47/2F	AE1	103	apple
16/10	CH	71	chalk	48/30	AW2	90	flaw
17/11	SH	121	shoe	49/31	UH2	71	about
18/12	Z	71	zoo	50/32	UH1	103	but
19/13	AW1	146	awful	51/33	UH	185	up
20/14	NG	121	ring	52/34	O2	80	toe
21/15	AH1	146	hot	53/35	O1	121	told
22/16	OO1	103	looking	54/36	IU	59	few
23/17	OO	185	foot	55/37	U1	90	you
24/18	L	103	laugh	56/38	THV	80	then
25/19	K	80	pick	57/39	TH	71	three
26/1A	J	47	judge	58/3A	ER	146	bird
27/1B	H	71	heart	59/3B	EH	185	wet
28/1C	G	71	gum	60/3C	E1	121	see
29/1D	F	103	fat	61/3D	AW	250	ball
30/1E	D	55	said	62/3E	PA1	185	no sound
31/1F	S	90	grass	63/3F	STOP	47	no sound

NOTES: 1) Duration is measured when the clock is adjusted to 720 KHz.
2) "T" must precede "CH" to produce "CH" sound.
3) "D" must precede "J" to produce "J" sound.

PHONEME CHART -- TABLE 1

INFLECTION LEVEL	VALUE TO ADD TO PHONEME
0	00/00
1	64/40
2	128/80
3	192/C0

INFLECTION LEVEL CHART -- TABLE 2

A) A1 AY Y
address UH2 D R EH1 S S
after AE F T ER
again UH1 G EH N
and AE1 EH3 I3 N D
answer AE1 I3 N S R R
apple AE1 EH3 P UH3 L
April A1 AY P R UH3 L
at AE1 EH3 T
August AW G EH2 S T

B) B B E Y
before B E1 F O R
begin B E1 G I3 I1 N
but B UH1 UH3 T
by B AH1 E1

C) S S E Y
call K AW L
can K AE EH3 EH3 N
car K AH R
cents S EH3 EH1 N S
change T CH EH3 A1 Y N D J
check T CH EH K
clock K L AH1 UH3 K
correct K R R EH1 K PA0 T

D) D D E Y
data D A1 AY DT UH2
date D A1 AY Y1 T
day D EH3 A1 AY
December D Y1 S EH2 EH2 M B R
degrees D I2 G R E1 Y Z
did D I D
dime D AH1 EH3 Y M
direction D ER EH1 K SH UH3 N
divide(d) D I3 V AH1 UH3 E1 D
does D UH1 UH1 Z (E1 D)
dollar D UH3 AH1 L UH3 R
done D UH1 UH3 N N

E) E1 E1 Y
east E Y1 S T
eight A1 AY Y1 T
eighteen A1 AY Y1 T PA0 E1 E1 N
eighty A1 AY Y1 D Y
eleven UH3 L EH1 V EH3 N
enter EH1 N T ER
equal E K W UH3 L
exit EH1 EH3 G PA0 Z I1 I3 T

F) EH EH2 F F
face F A1 AY Y1 S
fall F AW L
fast F AE EH3 S T
February F EH1 B Y1 U1 EH3 I3 R E1
feet F E T
fifteen F I1 F T E1 E1 N
fifty F I1 F T Y
first F ER R S T
five F UH3 AH1 E1 V
flower F L AH1 W ER
foot F OO1 OO1 T
forty F O1 R DT Y
four F O R
fourteen F O R T PA0 E1 E1 N
Friday F R AH1 E1 D A1 AY
from F R UH1 M

G) D D J E Y
gave G A1 AY Y V
get G EH1 EH2 T
give G I1 I2 V
good G OO1 OO1 UH3 D
grade G R A1 AY Y1 D

H) A1 AY Y1 T CH
has H AE I3 Z
have H AE UH3 V
he H E
heart H AH1 R T
hello H EH1 UH3 L UH3 O2 U1
her H ER R
his H I Z
hour AH1 U1 ER
hundred H UH1 N D R EH2 D

I) AH I2 Y
in I N
inch I1 N T CH
inside I3 N S AH1 E1 D
is I Z
it I1 T

J) D D J A AY Y
jacket D J AE1 EH3 K EH3 T
January D J AE1 I3 N Y1 U1 EH3 I3 R E1
July D J IU L AH1 E1
jump J UH1 UH2 M P
June D J IU U N

K) K K A AY Y

L) EH1 EH3 L
left L EH2 UH3 F T
light L UH3 AH2 Y1 T
live L I1 V
love L UH1 UH1 V

M) EH1 UH3 M M
man M AE EH3 N
manage M AE1 EH3 N I3 D J
March M AH1 UH3 R T CH
May M EH3 A1 AY
me M E
men M EH1 I3 N
mile M AH1 I3 UH3 L
million M I1 L Y1 UH3 N
minus M AH1 Y N UH3 S
minute M I1 N I3 T
Miss M I2 S S
Monday M UH1 N D A1 AY
month M UH1 N TH
Mr. M I2 S T ER
Mrs. M I1 S I2 Z
multiply M UH1 UH2 L T UH2 UH3 P L AH1 EH3 Y

N) EH1 EH2 N N
name N A1 AY Y M
negative N EH1 EH3 G UH2 T I1 V
newspaper N IU U1 Z P A1 AY P R
nickel N I1 I3 K UH3 L
nine N AH1 I3 Y N
nineteen N AH1 I3 Y N T E1 E1 N
ninety N AH1 I3 Y N T Y
no N UH3 O1 U1
north N O R TH
not N AH1 T
November N O1 V EH2 EH3 M B ER
number N UH2 UH3 M B ER

O) O U1
o'clock O1 K L AH1 K
October AH1 K PA0 T O2 U1 B R
of UH2 V
off AW F
on AH UH3 N N
one W UH N
open O P UH3 N
out AH1 U1 T
outside AH2 UH3 U1 T S AH1 EH3 Y D
over O1 U1 V ER

SPEAKEASY WORD LIST - Table 3

P) P P El Y
paid P Al AY Y D
paper P Al AY P ER
penny P EHl EH3 N Y
percent P R S EHl N T
phone F O Ul N
please P L El El Z
plus P L UHl UH3 S S
positive
postage P Ol S T I3 D J

Q) K K Yl IU Ul Ul
quarter K W Ol R T ER
question K W EHl S T CH UH3 N
quiet K W AHl Y EH3 T
quit K W Il T
quite K W UHl Y T

R) AHl AH2 ER
report R El P Ol R T
return R El T ER R N
right R AH2 UH3 El T

S) EHl EH3 S S
said S EHl I3 D
Saturday S AEl EH3 DT R D Al AY
school S K Ul Ul L
second S EHl K UH2 N T
September S EH2 P T EHl M B R
seven S EHl V EH3 N
seventeen S EHl V EH3 N T El El N
seventy S EHl V EH3 N D Y
several S EHl V R UH3 L
she SH El El
signal S Il G N UH3 L
six S Il K S
sixteen S Il K S T El El N
sixty S Il K S T Y
south S AHl O2 Ul TH
spring S P R Il NG
stamp S T AEl EH3 M P
start S T AHl R T
state S T Al AY Yl T
statement S T Al AY T M EH3 N T
stop S T AH UH3 P
store S T O R
sub S UHl UH2 B
sum S UHl UH2 M
summer S UHl UH2 M ER
Sunday S UHl N N D A2 AY

T) T T El Y
talk T AW K
teacher T El T CH ER
telephone T EHl L UH3 F Ol Ul N
television T EHl L UH3 V I2 ZH UH3 N
ten T EH3 THl N
that THV AEl EH3 T
the THV UH3 UH3 UH3
them THV EHl EH3 M
then THV EHl EH3 N
there THV EH2 A2 R
these THV El El Z
thirty TH ER R T Y
thirteen TH R ER T PAO El El N
this THV I S
thousand TH AHl UH3 Ul Z EH3 N D
three TH R El Y
Thursday TH TH ER R Z D Al AY
time T AHl El M
today T UH2 D A AY
total T Ol Ul T UH3 L
try T R AHl I3 AY
Tuesday T IU Ul Ul Z D Al AY
twelve T W EH2 EH3 L V
twenty T W EH2 EH3 N T Y
two T IU Ul Ul

U) Y IU Ul Ul
until UH2 N T Il UH3 L
use Yl IU U Z

V) V V E Y
voice V Ol UH3 El S
volume V AHl L Yl Ul M

W) D UHl B UH3 L Yl IU Ul
walk W AW K
watch W AW2 AHl T CH
Wednesday W EHl N Z D Al AY
west W EHl S T
what W UHl T
when W EHl N
where W EH2 A2 R
which W Il T CH
why W UH3 AHl El
winter W Il I3 N T ER
with W I2 TH
without W I2 TH UH3 AH2 Ul T
woman W OOl M UH3 N
women W Il M UH3 N
would W Ul IU IU D
wrong R AW NG

X) EHl EH3 K PAO S

Y) W AHl I2 Y

Z) Z Z E Y
zero Z Il R UH3 Ol